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The mechanism of beneficial effect of radiofrequency therapy on masticatory muscles in temporomandibular disorders — a literature review

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Abstract: Temporomandibular disorders (TMD) is one of the most common problem in contemporary dentistry. It is a term covering dysfunction of the masticatory muscles and the temporomandibular joints. Patients are suffering from severe pain, followed by limited mandibular opening and sounds in the temporomandibular joints during jaw movement. TMD influences the quality of life because the symptoms can become chronic and difficult to manage.
Radiofrequency waves (RF) are electromagnetic waves with low energy and high frequency. They provide pain relief without causing significant damage to the nervous tissue. The RF therapy is commonly used for physiotherapeutic treatment of skeletal muscle relaxation, as a supportive therapy. The rehabilitation effect of these waves is based on diathermy by means of high-voltage quick alternating current. RF has also found application in physical therapy, as a therapeutic tool for various types of chronic pain syndromes. The aim of this literature review is to show the beneficial effect of radiofrequency waves on the pain of the masticatory muscles in the course of TMD.

Keywords: radiofrequency, temporomandibular disorders, physiotherapy, supportive treatment.

Temporomandibular disorder

Temporomandibular disorders (TMD) include dysfunction of the masticatory muscles, the temporomandibular joints and the surrounding structures. The terms and definitions describing temporomandibular disorders have developed along with the progress in scientific research and diagnostic methods. The classification proposed by Okeson (2013) distinguished: masticatory muscle, temporomandibular joint, chronic mandibular hypomobility and growth disorders. Okeson also presented five etiological factors associated with TMD: occlusal factors, emotional stress, maxillofacial trauma, deep pain input and parafunctions [1].

The etiopathogenesis of TMD indicates the great importance of negative effect of chronic emotional stress. Increased emotional tension; associated with the stress of contemporary life; contributes to the formation of parafunctions. Parafunctional activity can be divided into two types: occlusal and non-occlusal. Depending on the patient's personality and ability to cope with stress, symptoms from the stomatognathic system appear at various level of destructive changes [2–8]. Occlusal parafunctions are related to excessive, uncontrolled contacts of the teeth in central occlusion (bruxing) and other occlusal relationships (grinding). Non-occlusal parafunctions occur without interdental contacts during chronic gum chewing, nail biting, or occupational habits as thread-biting [9–12]. The TMD present myofacial pain of the masticatory muscles, which arises from clenching, bruxing, or other parafunctional habits causing masticatory musculature strain, spasm, pain and functional limitations. Soreness includes chronic pain of the masticatory muscles with radiating pain to the ears, neck, and head [1, 5, 13–16].

The prevalence of TMD is also influenced by iatrogenic failure, including non-anatomical shape of dental fillings, incorrect reconstruction of interdental points, insufficient reduction of filling height or prosthetic restoration's failure. The role of maxillofacial trauma should also be mentioned, for instance sudden, acute injury leading to the damage of anatomical structures (traffic accidents) as well as chronic microtrauma with tissue damage (parafunctions) [1, 5, 17–20].

Clinical diagnosis of TMD requires a broad knowledge in general medicine, concerning that its symptoms can be a component of many chronic systemic diseases, such as rheumatoid arthritis (restriction of joint mobility, pain during abduction of the mandible), multiple sclerosis (facial muscle paralysis, impaired mobility), myasthenia gravis (excessive fatigue of the masticatory muscles, difficulties in chewing and swallowing), Parkinson's disease (jaw shaking, difficulties in chewing) or stroke (unilateral paresis, difficulties in chewing and swallowing). In many cases, the proper treatment can alleviate the symptoms. Abnormal functioning of the temporomandibular joints may also be accompanied by congenital genetic defects; such as: cleft jaw, Crouzon syndrome, Apert syndrome, Goldenhar syndrome, or ectodermal dysplasia, but it is rather rare [18, 21, 22].

Diagnosing TMD is based on both medical history and physical examination. Physical examination includes a general assessment of the head and neck, palpation of the masticatory muscles, functional occlusal analysis, examination of jaw opening and closing path, and palpation of the temporomandibular joints and muscles. The specific treatment plan varies depending on diagnosis and severity of the symptoms. The main goal of the therapy is to reduce the pain of the temporomandibular joints and the tension of the masticatory muscle [23–28].

Radiofrequency therapy

Radiofrequency (RF) is an electromagnetic wave with radiation frequency between 3 Hz and 3 THz. The main advantage of RF energy in medicine is the low or minor reaction of the nerves to high frequency alternating current. Thus, RF have become an irreplaceable therapeutic tool in almost every field of medicine including dentistry, dermatology, plastic surgery and esthetic medicine. The use of RF current; as a form of supportive therapy; has also found application in physical therapy as a therapeutic tool for various types of chronic pain syndromes [29–31]. Due to its efficacy and lack of side effects, RF is widely used during the treatment of m igraine headaches, trigeminal neuralgia, spinal pain and joints pain [32–38]. A beneficial effect of RF can also be observed on skeletal muscles. The use of radio waves is an effective method of rehabilitation in both orthopedics and traumatology. In addition, there are reports in medical literature about the positive effects of radio wave therapy in the treatment of lumbar spinal pain and tendinitis of the foot [39–41]. Therapy with radio waves has also found positive application during the treatment of pudendal neuralgia, and hemorrhoids [42, 43].

Contraindications to RF therapy include pregnancy, the presence of metal elements in the area of therapy (plates and screws after osteosynthesis), tumors, skin diseases, open wounds, the acute phase of thyroid diseases and muscular dystrophy. Special care should be taken when performing procedures in patients with thrombosis, cataracts, psychosis, pacemakers, or tuberculosis [36–43].

Physical basis

A RF current is an alternating current of low energy and high frequency. At the point of contact with biological tissue it causes oscillation of molecules, friction and heat generation. If the current is applied for an appropriate length of time, an effective energy is being generated to coagulate or stimulate the target tissues. The use of RF for therapeutic purposes requires the use of an electrical circuit that is similar to the circuit used in monopolar diathermy. One of the arms of the circuit passes from the RF generator to a non-therapeutic site on the patient's skin. The second arm of the circuit passes from the RF generator to the head of the device. When the electrode is in the target (therapeutic) place, a current begins to flow between the electrodes and generates an electric field. The current has sufficient density on the insulated tip of the electrode to generate the heat [44–48].

The using of RF current during analgesic therapy varies depending on its modality, which can be differentiated into continuous (CRF) or pulse (PRF). Continuous radiofrequency (CRF) is the process that causes the discontinuation of nociceptive afferents. For the treatment of chronic pain syndromes, radiofrequency procedures use current in the AM/RF band, exerting a direct effect on the pain pathways. RF current with continuous wave characteristics is used to treat trigeminal neuralgia, cervical-muscular headache, tumor pain and somatic back pain [49–51].

Biological impact

The mechanism of RF therapy is based on the oscillation of the electric current. The electromagnetic waves are converted into thermal energy, which is being released around the tip of the electrode. The main therapeutically influential factor is internal heat generated in the treated tissue. The heat arises as a result of the widening of the blood vessels, stimulation of metabolic processes, an increasing the number of leukocytes and reduction of excitability in the musculoskeletal nervous system. Raising the temperature of the skin, combined with this gentle massage, induce the muscle relaxation and its analgesic effect. This is accompanied by the effect of vasodilatation with the improvement of tissue blood supply, which contributes to the acceleration of metabolic processes and the stimulation of regenerative processes. It promotes the formation of microcirculation (dilatation of blood vessels), which improves its oxygenation and nutrition. In well-hydrated tissues (muscles, skin) the amount of heat is greater than in tissues with low electrolyte content (bones). The content of subcutaneous fat tissue influences its impedance to thermal effect of RF therapy. The amount of generated heat depends also on intensity of the current, its frequency, the size of electrodes, mutual configuration. Various tissues have different contents of electrolytes and different levels of hydration. The high variable frequency electric current, created between the electrodes, causes the movement of ions in the tissue electrolyte — negative ions migrate towards the anode, positive towards the cathode. As a result, ion polarization occurs; which causes the displacement of charges and a change in the spatial orientation of non-ionized molecules. The heat is also generated in the tissue as a by-product of the reaction [44, 45].

Methodology of the procedure

Factors affecting the distribution of the heat inside the tissue are geometry and placement of the electrodes. Two kinds of treatment techniques are used in RF devices. The heat distribution created by these configurations is different. Current flows only when the electric circuit is closed — two poles/electrodes are always required. In the medical literature, the following nomenclature has been adopted: monopolar technology and bipolar technique [43, 46, 48].

The monopolar (unipolar) technique is carried out using an active electrode (smaller size). The second electrode fulfills the task of the electrode closing the electrical circuit. Adjustment of physical parameters reduces the risk of adverse reactions, such as excessive overheating or burning. The right temperature can be obtained by applying pulses with adequate energy [52].

Treatment of temporomandibular disorders

The initial phase of TMD treatment consists of reducing the muscle tension of the masticatory muscles and thus obtaining an analgesic effect in the muscles and temporomandibular joints [1–3, 5, 6]. The main methods of the treatment of TMD disorders are the use of occlusal splints and physiotherapeutic rehabilitation (laser biostimulation, sonophoresis and iontophoresis, manual therapy, kinesitherapy, electromagnetic field and LED light therapy, poisometric muscle relaxation) as supportive treatment [53–59].

Radiofrequency waves are used as a supportive treatment of the masticatory muscle relaxation in the course of TMD of stomatognathic system. It reduces excessive tension and activity of masticatory muscles, which effectively improves the coordination of the stomatognathic system and reduces pain in the soft tissues surrounding the temporomandibular joints [52, 60].

The therapy procedure is conducted by repeatedly passing the head of the RF device over the surface of the masticatory muscles. The amount of the heat is related to thermoregulatory properties of the tissues. The electrodes have usually a built-in temperature sensor. This sensor provides information about the temperature during the procedure, which allows to control and protects against dangerous overheating. The obtained temperature is displayed on the screen. The program of the RF device allows for dosing the amount of energy to keep the temperature at the constant and defined level. Modern RF devices can be equipped with the additional safety system. The patient holds in hand an emergency button, which switches off the flow of the current immediately after it is pressed. The RF current dosage should also be fitted to patient’s feedback. The duration of the procedure is usually about 10 minutes, depending on the indications, applied dose and the size of the area. In TMD it is indicated to set the energy of 20J, the frequency at 3 MHz, bipolar technique, and the duration 10 times in the series with coupling substance — gel for ultrasound examinations [60].

Summary

The results of this literature review clearly indicate that the radiofrequency therapy is an effective treatment in the course of TMD of stomatognathic system. Its beneficial effect is to restore physiological function of the masticatory muscles by improving blood circulation and thus obtain an analgesic effect. This method is noninvasive, and it should be recommended as an important method in supportive treatment of temporomandibular disorders.

Conflict of interest

None declared.

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